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# Distributions of Armoured Scale Insects Infesting Citrus Trees in Different Localities in Egypt

M.E. Tawfeek
Department of Applied Entomology, Faculty of Agriculture, El-Shatby, Alexandria University, Egypt

## ABSTRACT

The distributions of five armoured scale insect species attacking different species and varieties of citrus trees were studied in nine provinces in Egypt viz., Alexandria, Beheira, Gharbia, Menoufia, Kafr El-Sheikh, Qalyubia, Sharkia, Dakahlia and Ismailia during the growing seasons from 2008 through 2010. Tree branches carrying colonies of diaspidid species were brought to the laboratory for identification and counting the populations. Five armoured scale insect species representing four genera were collected and identified. These were: *Lepidosaphes beckii* (Newm.), *Parlatoria ziziphi* (Lucas), *P. pergandii* Comstock, *Aonidiella aurantii* (Maskell) and *Chrysomphalus aonidum* (L.). However, *P. ziziphi* dominated in Menoufia; *C. aonidum* had very high in numbers in Qalubia, Kafr El-Sheikh and Gharbia; *L. beckii* was abundant in Alexandria and Sharkia; *A. aurantii* distributed in Beheira, Ismailia and Menoufia and *P. pergandii* was found in a few numbers in Alexandria. On the other hand, the susceptibility and rate of infestation per leaf and per $cm^2$ of leaf by the dominant armoured scale insect species, *P. ziziphi* on citrus trees were observed in Shibin El-Kom alone. The present study indicated that the level of infestation of armoured scale insect species differed from one location to the other.

**Key words:** Armoured scale, insect species, citrus trees, *Parlatoria ziziphi*, *Lepidosaphes beckii*, *Aonidiella aurantii*, *Chrysomphalus aonidum*

## INTRODUCTION

Armoured scale insects (Homoptera: Diaspididae) with piercing and sucking mouthparts are considered among the most injurious plant pests. They attack different agricultural crops, such as fruit trees and ornamental plants all over the world and cause heavy damage to the plants. Individual species infest leaves, fruit, branches, main stems, trunks and roots. They are distributed throughout the world except in the cold extremes of the Arctic and Antarctic regions. The infested fruits lose their marketing value because it is difficult to remove the insects from the produce. Many diaspidid species are also of quarantine concern requiring management to prevent their spread through export of plant products (Gullan, 2001; Miller, 2005; Miller *et al*., 2005).

In Egypt, citrus plantations are among the most important horticultural crops especially grown for the export of their fruits. Many researchers have recorded armoured scale insects attacking citrus trees in Egypt (Habib and Attalah, 1960; El-Keiy, 1964; Habib *et al*., 1971; Darwish, 1976; Abd-Elfattah *et al*., 1978; Amin and Salem, 1978; El-Rahman *et al*., 1979; El-Nabawi *et al*., 1986; El-Nabawi and Ammar, 1987; Farag *et al*., 1990; Tawfeek, 2007). Of late, in comparison with the earlier surveys, some changes in the populations of scale insects were observed. However, latest reports on the patterns of their distribution are not available. Therefore, this work was carried out to identify the species of armoured scale insects which attack citrus plants and to make a

comparison of their dominance in nine different localities in Egypt. The main purpose of the study was to record the susceptibility of different citrus varieties to the infestation of the black parlatoria scale insect, *Parlatoria ziziphi* (Lucas).

## MATERIALS AND METHODS

The armoured scale insects attacking different species and varieties of citrus trees were studied in nine provinces in Egypt during the growing seasons of 2008 till 2010. These were: Alexandria (Abbies), Beheira (El-Azimah), Gharbia (Berma), Menoufia (Shibin El-Kom, Menoff), Kafr El-Sheikh (Beila), Qalubia (Kafr Shoker), Sharkia (Menia El-Kamh), Dakahlia and Ismailia (Wady El-Molak as a new reclined land, Kantrah Shark and Fayed).

Twenty small branches (about 15-20 cm) with leaves carrying colonies of diaspidid species were plucked at random from different directions and heights of the chosen citrus trees (at about 150-200 cm height) in the different nine localities. The collected branches with live specimens were taken to the Laboratory of Department of Applied Entomology, Faculty of Agriculture. El-Shatby, Alexandria University, for identification and counting the populations of scale insects. Preparation of slides and identification were carried out following the methodology of Kosztarab and Kozar (1988).

The population densities and degrees of infestations of the ziziphi scale insect on different species and varieties of citrus were studied at the Research Farm of the Faculty of Agriculture, Shibin El-Kom. Samples of infested plants (more than 100 leaves) were brought to the laboratory for inspection. The data were recorded on total numbers of adult (females, males) and immature stages (other than movable crawlers) per leaf on both upper and lower surfaces of leaves.

**Statistical analysis:** Data were subjected to the analysis of variance test (ANOVA), with mean separation at 5% levels of significance, Computer program IRRISTAT and Duncan's Multiple Rang Test was used to compare the averages according to the method of Snedecor and Cochran (1967).

## RESULTS AND DISCUSSION

**Distribution of armoured scale insects on citrus trees:** Five armoured scale insect species representing four genera belonging to the family Diaspididae were collected and identified from citrus trees in the nine provinces under consideration during 2008 through 2010. These were: the purple scale insect *Lepidosaphes beckii* (Newm.), the ziziphi, ebony or black parlatoria scale insect *Parlatoria ziziphi* (Lucas), the chaff scale insect (*P. pergandii* Comstock), the Florida red scale insect (*Aonidiella aurantii* (Maskell)) and the black scale insect and *Chrysomphalus aonidum* (L.).

Data in Table 1 presents the species compositions of the armoured scale insects infesting citrus trees in the nine localities under study. These data revealed that the level of infestation of armoured scale insect species differed from one location to the other. The purple scale insect, *L. beckii* occurred in all the nine localities; it had a high infestation in Alexandria and a moderate in Beheira, Menoufia, Qalubia and Sharkia. The ebony scale insect, *P. ziziphi* occurred only in two localities (Menoufia had a high infestation and Qalubia a moderate). The chaff scale insect, *P. pergandii*, was found only in Alexandria in few numbers. The red scale insect, *A. aurantii*, was found in all the nine localities with different degrees of infestations. It had high infestation in Beheira, Menoufia, Sharkia, Ismailia, a moderate in Dakahlia, while a weak infestation in Alexandria, Gharbia and Kafr El-Sheikh. The black scale insect, *C. aonidum*, occurred in all the

Table 1: Distributions of five armoured scale insect species on citrus trees in nine different localities in Egypt from 2008 through 2010

| | Armoured scale insect species | | | | |
|---|---|---|---|---|---|
| Locality | *L. beckii* | *P. ziziphi* | *P. pergandii* | *A. aurantii* | *C. aonidum* |
| Alexandria | *** | - | * | * | - |
| Beheira | ** | - | - | *** | * |
| Gharbia | * | - | - | * | *** |
| Menoufia | ** | *** | - | *** | * |
| Kafr El-Sheikh | * | - | - | * | *** |
| Qalubia | ** | ** | - | * | *** |
| Sharkia | ** | - | - | *** | ** |
| Dakahlia | ** | - | - | ** | *** |
| Ismailia | * | - | - | *** | * |

*Weak infestation (5-10 individuals/leaf), **Moderate infestation (11-20 individuals/leaf), ***High infestation (more than 20 individuals/leaf), -: No infestation

eight localities and was absent in Alexandria. In Gharbia, Kafr El-Sheikh, Qalubia and Dakahlia a high infestation was noticed whereas it was moderate in Sharkia and weak in Beheira, Menoufia and Ismailia.

El-Keiy (1964) reported that *Chrysomphalus ficus* Ashm. (*C. aonidum* L.), was in the maximal numbers of scale insect species on citrus plants in Shibin El Kom, Menofia. Darwish, (1976) stated that the purple scale insects, *L. beckii* was the most abundant species infesting citrus trees in the same farm during 1974 and 1975 growing seasons. Meanwhile, El-Nabawi and Ammar (1987) found that *A. aurantii* was the most abundant species in the same orchard. Farag *et al.* (1990) indicated that the purple scale insect was the major pest infesting citrus trees in the same region followed by the red scale insect and *P. ziziphi* was at third place. Tawfeek and Abu-Shall (2010) observed that *P. ziziphi* on navel orange trees had three annual peaks of abundance in Shibin El-Kom. Nowadays, as a result of interspecific competition among armoured scale insect, the black parlatoria scale insect, *P. ziziphi* has become the most dominant species on citrus in Shibin El-Kom, Menoufia.

The present results, to some extant, agree with the findings of Kamel (2010) who recorded *A. aurantii* and *P. ziziphi* on citrus trees (Baladi and Navel Orange) at Al-Qalyubiyah Governorate, Egypt. The present results agreed with that of Miller and Kosztarab (1979) who stated that citrus may be heavily infested by a particular coccoid in one area, whereas it may be immune to attack in another area.

In Alexandria, Karam (1979) recorded that the diaspidid insects on citrus, arranged in a descending order according to their abundance, were: *P. pergandii*, *L. beckii* and *A. aurantii*. However, in the present study *L. beckii* was the most abundant and the two other scale insects were found in a few number.

Gerson (1977) mentioned that the chaff scale, *P. pergandii* was a pest of citrus in Israel. It infested 10-12 years old trees, attacking leaves, fruit and bark. Three to four generations occurred on leaves, the live scale populations ebbing during early summer.

**Susceptibility to infestation by *P. ziziphi* of different citrus species:** The level of infestation per leaf and per $cm^2$ of leaf by the dominant armoured scale insect species (*P. ziziphi*) on ten citrus tree types were observed in Shibin El-Kom only. Susceptibility of citrus trees to

Table 2: Abundance of the ziziphi scale insect, *P. ziziphi* per leaf on ten citrus tree species and infestation percentage of leaves in Shibin El-Kom during the growing season of 2009/2010

| Citrus trees | | Mean no. of scale insect per leaf | | | | Infestation per 100 leaves (%) | |
|---|---|---|---|---|---|---|---|
| Common name | Scientific name | Upper | Lower | Mean of leaf area ($cm^2$)* | Mean no. of insects per ($cm^2$)** | Upper | Lower |
| Navel orange | *Citrus sinensis* | 270.0$^{ab}$ | 48.3$^{ab}$ | 24.57 | 6.48 | 96 | 73 |
| Sweet orange | | 398.9$^{a}$ | 41.0$^{ab}$ | 27.14 | 8.10 | 94 | 59 |
| Baladi orange | | 175.0$^{ab}$ | 6.2$^{b}$ | 20.63 | 4.39 | 92 | 43 |
| Sour orange | *Citrus aurantium* | 303.0$^{ab}$ | 38.8$^{ab}$ | 31.20 | 5.48 | 98 | 82 |
| Grapefruit | *Citrus paradisi* | 160.1$^{ab}$ | 49.3$^{ab}$ | 35.64 | 2.93 | 79 | 63 |
| Mandarin | *Citrus reticulate* | 159.2$^{ab}$ | 7.6$^{b}$ | 8.35 | 9.98 | 87 | 42 |
| Adalia lemon | *Citrus limon* | 464.7$^{a}$ | 56.5$^{a}$ | 43.94 | 5.93 | 93 | 87 |
| Lime | *Citrus aurantifolia* | 39.9$^{b}$ | 1.8$^{b}$ | 14.23 | 1.46 | 36 | 15 |
| Sweet lime | *Citrus limetta* | 218.6$^{ab}$ | 15.0$^{b}$ | 53.00 | 2.20 | 96 | 33 |
| Kumquats | *Fortunella margarita* | 7.8$^{b}$ | 1.2$^{b}$ | 7.39 | 0.53 | 10 | 2 |

*Average of leaf area per $cm^2$ based on measurement of area of 10 leaves for each citrus kinds, LSD: 208.26 for upper surface and 38.34 for lower surface, **Total No. of insects on upper and lower surface area of leaf ×2, In a column, means followed by the same letter are not significantly different at the 5% level by DMRT

infestation was differed from one species or variety to another. In general, all stages of black parlatoria scale insects were present in the farm all the year-round, indicative of overlapping generations. However, this scale insect was more abundant on leaves collected from the interior of the tree canopy than the exterior canopy.

Data shown in Table 2 indicated that the upper surfaces of leaves were infested by higher numbers of *P. ziziphi* than that of the lower surfaces on all citrus tree kinds.

The highest mean numbers of this scale insect species on the upper surfaces of leaves was recorded on Adalia lemon (464.7 individuals/leaf) followed by sweet orange (398.9 individuals/leaf) then sour orange (303.0 individuals/leaf), while the lowest mean numbers was noticed on kumquat leaves (7.8 individuals/leaf). On the other hand, the highest mean numbers of *P. ziziphi* infested the lower surfaces of leaves was also on Adalia Lemon (56.5 individuals/leaf) followed by Grapefruit (49.3 individuals/leaf), Navel orange (48.3 individuals/leaf), while the lowest mean numbers was found on Kumquat leaves (1.2 individuals/leaf).

The present results support the findings of Darwish (1976) who found and reared this insect species on the upper surfaces of Mandarin leaves under the natural field conditions for the first time in Shibin El-Kom. Host plants often show varying degrees of susceptibility to particular scale insect (Miller and Kosztarab, 1979). Saighi (2006) investigated the effect of chemical constituents of lemon and clementine tree on the invasion of *P. ziziphi*. The results of mineral analysis showed that there was a larger amount of potassium in lemon tree than in the clementine tree, which was most infested. Sellami and Biche (2006) found that *P. ziziphi* had four generations per year in the area of Boufarik, in Mitidja, Algeria and the plant host and the climate influenced the distribution, evolution and also the mortality of the individuals. Black parlatoria was discovered infesting citrus trees in southern Florida in 1985 (Capinera, 2008).

Noticeably, induced data in Table 2 revealed since the leaf area of the ten citrus varieties differed from one variety to another therefore, it is more accurate to calculate the number of insects per 1 $cm^2$. The largest mean area was measured in Sweet lime (53.0 $cm^3$) followed by lemon (43.9 $cm^2$) Grapefruit (35.6 $cm^2$), Sour orange (31.2 $cm^2$), while the smallest leaf area was recorded

for Kumquats (7.3 $cm^2$). However, the mean numbers of *P. ziziphi* per $cm^2$ occurred in higher number on Mandarin leaves (9.95 individuals/$cm^2$) followed by Sweet orange (8.10 individuals/$cm^2$) and the smallest one was on Kumquats (0.53 individuals/$cm^2$).

The results in Table 2 revealed that although the highest population density was found on Adalia lemon per leaf, yet the insect population on the same host was at fourth rank of infestations (5.93 individuals per $cm^2$ of leaf); the population density on Mandarin took the first rank at 9.98 individuals per $cm^2$ followed by sweet orange, then naval orange, sour orange and kumquat which was at the last rank. The present results, However, do not agree with that of Farag *et al.* (1990) who observed the Mandarin leaves having light infestation.

Moreover, the level of infestation per 100 citrus leaves of all citrus varieties were calculated and recorded on both upper and lower surfaces of leaves (Table 2). In this respect, the occurrences or infestation level of *P. ziziphi* on the upper surfaces, in this descending order, was: Sour orange (98%), navel orange (96%), sweet lime (96%), sweet orange (94%), Adalia lemon (93%), Baladi orange (92%), mandarin (87%), grapefruit (79%), lime (36%) and the lowest one was kumquat (10%). On the other hand, the infestation level on the lower surfaces, in the descending order, was: Adalia lemon (87%), sour orange (82%), navel orange (73%), grapefruit (63%), sweet orange (59%), Baladi orange (43%), mandarin (42%), sweet lime (33%), lime (15%) and the lowest one was kumquat (2%).

Statistical analysis of data given in Table 2 showed that there were highly significant differences among the distribution and susceptibility of ten citrus trees to infestation by *P. ziziphi*. There were significant differences between the population densities on Adalia lemon and Sweet orange and that lime and kumquat. However, no significant differences were noticed either between the susceptibility of Adalia lemon and sweet orange or among the susceptibility of eight citrus types to infestation by this insect.

## CONCLUSION

Recently, some changes in the abundance of scale insects were observed. Therefore, this work aimed to identify the species of armoured scale insects, which attack citrus plants and to compare their dominancy in nine different localities in Egypt and to study the susceptibility of different citrus varieties to the infestation of the black parlatoria scale insect, *Parlatoria ziziphi* (Lucas). This study indicated that the dominations of armoured scale insect species were differed from a location to another. Both were differed from one species or variety to another.

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